

## Notes to Accompany a Topographical Map and a Provisional Geological Map of Great Island, Three Kings Group.

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The maps presented herewith have been compiled from surveys carried out during a visit of five days' duration to Great Island as a member of an expedition conducted by the Auckland War Memorial Museum, under the leadership of Dr. Gilbert Archey, in January, 1951. Some observations on the geology of the narrow waist of the island had been made during an earlier visit in 1948, when four hours were spent ashore.

### TOPOGRAPHIC WORK.

The bases of previous maps of the Three Kings Islands have been a sketch map of Great Island made by S. Percy Smith in 1887 (Cheeseman, 1891) and the Admiralty Chart of the whole group at the scale of 1:100,000 revised in 1911. Mr. E. G. Turbott, who spent five weeks on the island in 1946, took a number of compass bearings which he used to correct existing maps. His final map of the whole group (*Rec. Auckland Inst. & Mus.*, vol. 3, p. 190, 1948) unfortunately lacks a scale.

The horizontal control of the map now presented is a triangulation by prismatic compass bearings taken to prominent hill features and coastal promontories. Mr. Turbott, in his observations, used some of the same natural features as points of bearing and his readings have been checked with those of the later survey and show satisfactory agreement. Those taken from the conspicuous Rocky Knoll (750') at the head of Castaway Valley west of the narrow waist of the island were particularly useful.

The map depends for scale upon a short and roughly measured base between Bald Hill (601') and the spot height 577' on the crest of a rocky bluff to the south-east. A longer and more carefully measured base is the first requirement in any further work. Sites for such a base are few, but the open ridge north-north-west and south-east of Bald Hill offers scope for a much improved base-line, which could be expanded by observations to Rocky Knoll (750') and to the highest point of the island (920') on the cliffs above North West Bay, west of the landing place. A bearing picket on this high point would be helpful, as it is poorly defined from points of view lying to the south and south-east.

Vertical control was established by aneroid barometer corrected as far as possible for diurnal barometric changes by repeated readings. Weather conditions throughout the survey were exceptionally steady. The camp site was used as a base for the daily traverses, its height being taken as 315ft., the approximate mean of five pairs of reading at the camp and at sea level taken with the least possible lapse of time between them.

A great amount of detail was plotted with the aid of a large collection of excellent photographs of the island (particularly its coastline) taken by many different visitors and assembled by Mr. A. W. B. Powell, Assistant Director of the Auckland Museum.

## GEOLOGY.

In 1936 the late Professor J. A. Bartrum described spilite lavas and keratophyres from Great Island, this being the first record of the occurrence of rocks of the Spilitic Suite in New Zealand. The spilites were seen to exhibit pillow structure at a point which Professor Bartrum described to me in conversation as lying near sea level perhaps a quarter of a mile west of the landing place in North West Bay. Beyond the conclusion, based on microscopic texture, that the albitic porphyry that he described is a flat-lying sill and that probable keratophyre tuff is present, Professor Bartrum did not deal with the field relations of the rocks. He regarded the greater part of the island as being composed of greywacke.

In the course of the recent work only greywacke was found in the eastern part of the island, but very little sediment outcrops in the western part, to which the succeeding remarks on stratigraphy and structure chiefly apply.

The igneous rocks found in the western part of the island are of two kinds, apparently broadly the same as the two types described by Professor Bartrum. The basic (probably spilitic) lavas are seen to great advantage in the huge blocks that litter the shore east of the Landing Place in North West Bay. They are dark green when fresh, weathering yellow-brown. They are never conspicuously porphyritic, but in some cases long, slender feldspar laths are clearly visible to the unaided eye. The felted texture of fine feldspar microlites can generally be seen with a lens, even in weathered chips. Green chloritic spots are commonly seen, but coarser amygdaloidal structure is an inconstant feature. It may possibly be related in distribution to the tops of flows, for it seems to become more conspicuous as an overlying band of keratophyre is approached.

Pillow form was never observed (the classic locality could not be reached without a dinghy), but a tachylytic breccia forms the top of the crag (603') above Hapuka Point and the steep walls of this crag are worthy of further examination.

The keratophyres are characterized by their light weathering colours and a tendency to form low bluffs in the inland area. They exhibit in places a structure interpreted as flow-banding (see below). On the fresh surface they are of a vitreous or greasy lustre, dark to pale greenish or pale yellow, with a streaky inhomogeneous appearance and, often, conspicuous pink oblong feldspar phenocrysts in a groundmass that is structureless even under a lens.

A brecciated phase was found in four places, and three of these are believed to be of one horizon. It appears in hand specimen to be of the nature of a flow-breccia and not a consolidated pyroclastic deposit. This view is perhaps borne out by the uncertainty expressed by Professor



Bartrum whether the rock was a tuff or a flow. At a few places, for example near South Point, the rock takes on a nodular appearance, the nodules being the size of small marbles.

A detailed laboratory examination of the rocks collected on Great Island has not yet been made.

The courses of the traverses made during the recent survey are indicated on the geological map by the positions of outcrop symbols. It should be understood that those in the upper basin of Tasman Stream, south of the cliffs above North West Bay, are only approximately located, as the low forest prevents satisfactory compass bearings.

Observations of dip shown in the keratophyres in the basin of Castaway Stream and along the cliff top north-north-west of the camp were taken upon a planar structure in the rock which is interpreted as flow-banding. It is best displayed upon weathered surfaces, which exhibit discontinuous parallel grooves and ridges reaching about an inch in thickness and afford in places quite satisfactory readings. Laminated sediments intercalated in the basic lavas provided evidence of attitude in the northern cliffs and in the bed of Tasman Stream. Orientation of elongated amygdales in some of the lavas proved to be somewhat erratic and of little apparent value in suggesting the attitude.

On the basis of these observations and upon the distribution of the different lithological types the contacts between beds of basic lava and keratophyre have been extrapolated from points where they were found, so that they follow courses appropriate to the topography upon the assumption of a regular easterly dip of 25 degrees.

Important in this interpretation is the presence of a conspicuous and characteristic keratophyre breccia near spot height 823ft. on the crest of the northern cliff and in boulders at the Landing Place in North West Bay, but not eastward of the Landing Place. This is interpreted as indicating that the breccia reaches sea level near the Landing Place, although it is there masked by scree, and further examination is needed to prove its actual position. Similar breccia occurs at the same inferred horizon near South Point. The distribution of richly amygdaloidal basic lavas, interpreted as the tops of flows, appears to conform with the observed outcrop pattern, though the value of this indication is perhaps open to question.

The presence of a reddened zone at the contact of one type of lava with another has been noted at several places and, being conspicuous from a distance, serves as a useful guide to places where contacts may be sought in areas of bare ground. The contacts seen were all poorly displayed. Clayey weathered material usually masked the actual junction of the two rock types. A readily accessible contact, better than some in this respect, between basic lava below and weathered keratophyre above, may be seen on the cliff top on the north side of the narrow ridge joining the two parts of the island, a few yards west of its narrowest and lowest point. A contact between fairly fresh rocks in the northern cliff at 660ft. above sea level below spot height 823ft. shows a very irregular line of junction which, however, cannot be traced far.

The agreement between the observed rock distribution and the inferred boundaries on the map is satisfactory, as far as it goes, except that no keratophyre band was picked up on a traverse made on a fixed bearing westward from Rocky Knoll (750') to the proximal end of Hapuka Point spur (917'). Outcrops in the place where keratophyre should appear are, however, very sparse and obscure.

While it will be clear that much more remains to be done to check the correctness of the outcrop pattern, it is hoped that the accompanying maps will serve as a guide to future investigators. In particular, they provide a base upon which the positions of further rock samples can be fixed by any visitor who is not a geologist, and in this way advances in our knowledge may be made from time to time.

A few simple tests of the stratigraphic picture may be mentioned. The keratophyre encircling the head of Castaway Valley forms conspicuous white weathering bluffs and lines of boulders. The course of the inferred contact between the keratophyre and the underlying basic lava can easily be checked by any visiting naturalists.

A suite of specimens taken at intervals up the lower course of Tasman Stream, where it flows in a rocky channel, would be of immediate service, as would samples from the spur of white-weathering rock west of the mouth and lower part of Tasman Stream.

Careful work on the northern cliffs would also serve to verify the relationships. Unfortunately, screes obscure much of the accessible part; nevertheless, accessible outcrops are plentiful. A climb from the Landing Place to the cliff top, west of the route usually followed, appears quite feasible and would afford much information.

The relationship of the greywacke of the eastern part of the island to the igneous rocks is not known. The slopes around the head of South East Bay may afford information on this question. The material on the crest of the ridge linking the two parts of the island is weathered to clay, and the nature of the contact between greywacke and keratophyre cannot be seen. The extension of the greywacke to the cliff tops west of South East Bay is entirely hypothetical.

A large part of the eastern section of the island has a smooth, sloping surface underlain by sandy soil and, at East Point and the Point south of it, well-rounded pebbles that have weathered out of this sandy covering litter the ground. This surface, varying in height from 250ft. south of East Point to 325ft. where it merges into the higher ground along the cliffs east of North West Bay and into the ridge running south from these near their highest point (602'), is regarded as an elevated plain of marine erosion and deposition, with shore pebbles and a sandy cover upon it.

A cavernous buff sand-rock, often quite hard, is conspicuous in blocks in many parts of the island on both the eastern and western portions. A little east of the highest point (602') of the eastern part it overlies greywacke and encloses pebbles of igneous rock and greywacke with characteristic red weathering crusts upon them. Outcrops of this cavernous buff deposit also cap the cliffs near East Point and south of it. Masses of it have been found in the western portion of the island also, sometimes at heights greater than that of the plain of marine

erosion in the east, and with them pieces of igneous rock with a reddish weathering-crust. In general, it would seem that pieces of rock with this red weathering-crust should be regarded with deep suspicion, wherever they are found, although, in areas of poor outcrops in the upper Tasman Valley, it is tempting to accept them as float from the bed rock. This reddened crust on loose blocks is quite distinct from the reddening at stratigraphic contacts noted above.

A satisfactory explanation of the origin and distribution of the cavernous buff rock has not yet been found. The balance of probability seems to favour its origin as a superficial accumulation of some earlier higher stand of the sea. I believe that it should not be confounded with a compact buff clayey rock, generally soft, that occurs, for example, just below the lip of the cliff immediately north of the Castaways' Depot, as well as at other places, and seems to be sediment associated with the keratophyres.

#### REFERENCES.

A chronological list of investigations into the natural history of the Three Kings Group appears in *Records of the Auckland Institute and Museum*, Vol. 3, Nos. 4 and 5, 1948, pp. 191-193, and contains references to most scientific papers relating to the group. Two papers only need be mentioned here, the first of which has unaccountably been omitted from the above-mentioned list.

BARTRUM, J. A., 1936. Spilitic Rocks in New Zealand. *Geol. Mag.* 73, 414-423.

CHEESEMAN, T. F., 1891. Further Notes on the Three Kings Islands. *Trans. N.Z. Inst.*, 23, 408-424 (with map by S. Percy Smith).

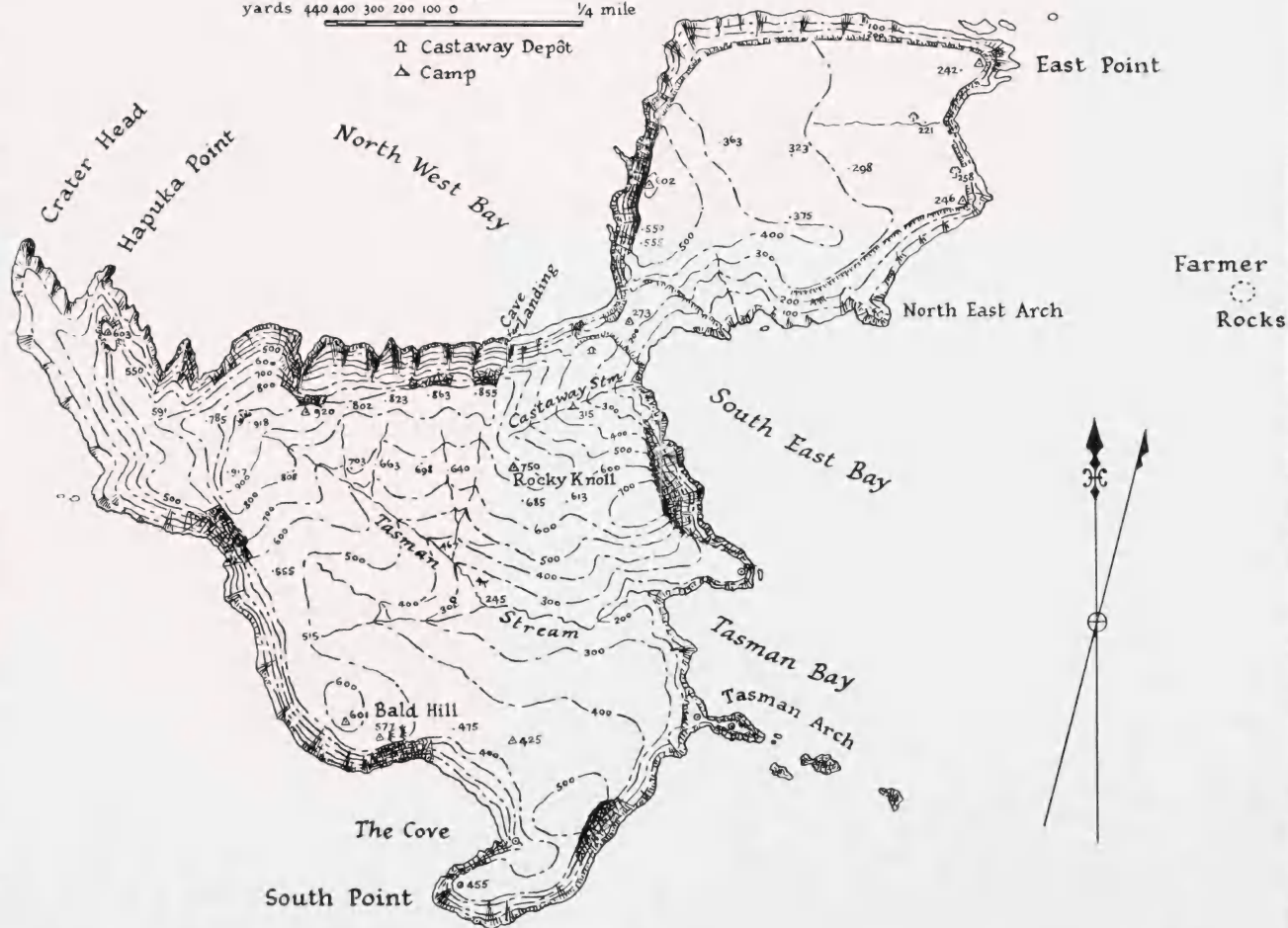


# MAP OF GREAT ISLAND, THREE KINGS GROUP

*made by M.H. Battey  
incorporating observations by E.G. Turbott & detail from  
numerous photographs*

Scale  
yards 440 400 300 200 100 0 1/4 mile

⬆ Castaway Depôt  
△ Camp



# GEOLOGICAL MAP OF GREAT ISLAND, THREE KINGS GROUP

Scale

yards 440 0 1/4 mile

